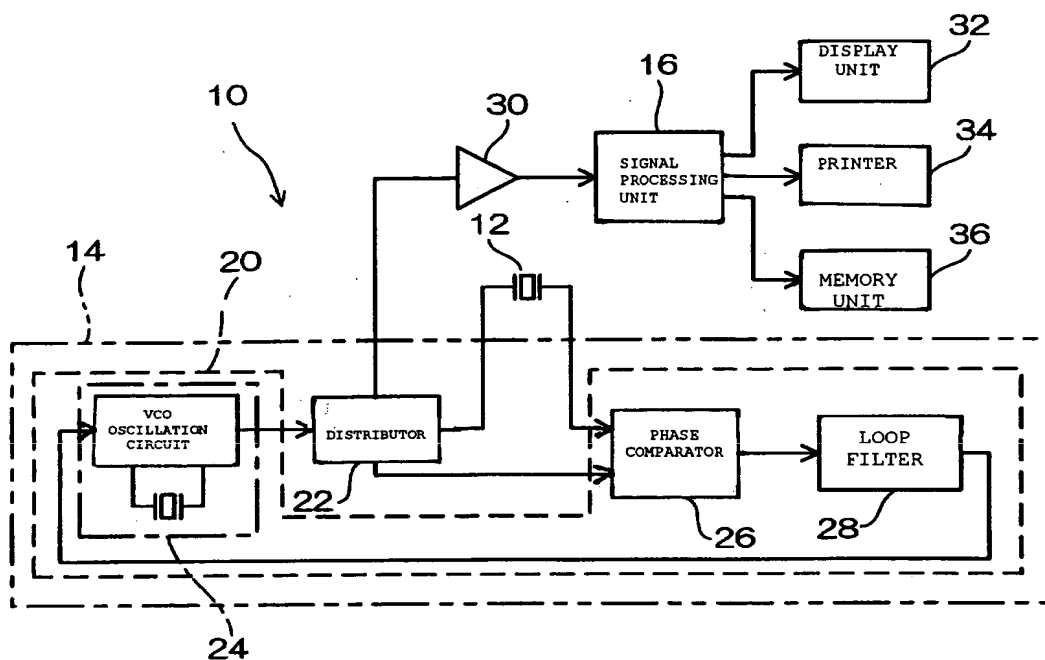




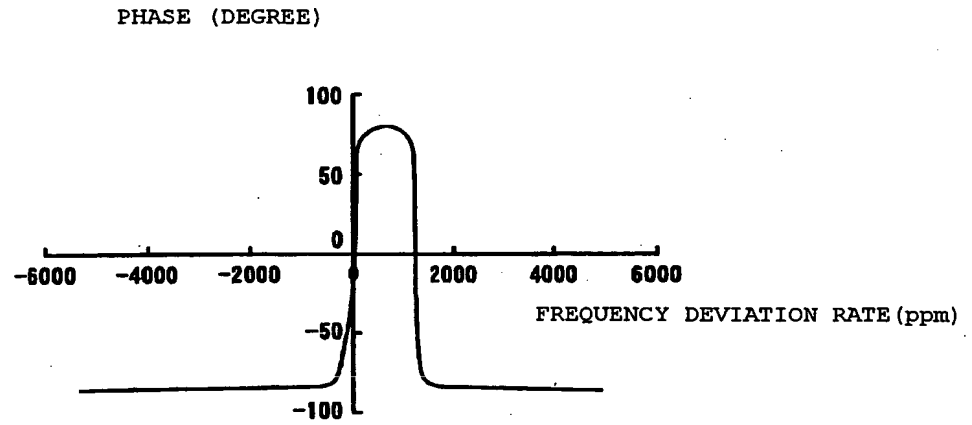
FIG. 1



- 10: MASS MEASUREMENT APPARATUS
- 12: PIEZOELECTRIC VIBRATION REED FOR MASS MEASUREMENT
- 14: EXCITATION CIRCUIT
- 16: SIGNAL PROCESSING UNIT
- 20: PLL CIRCUIT
- 24: PRESSURE CONTROLLED OSCILLATOR

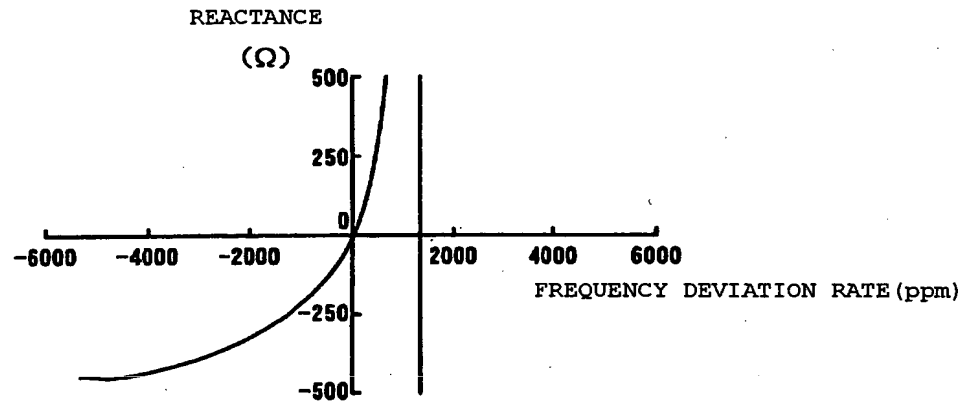
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FIG. 2



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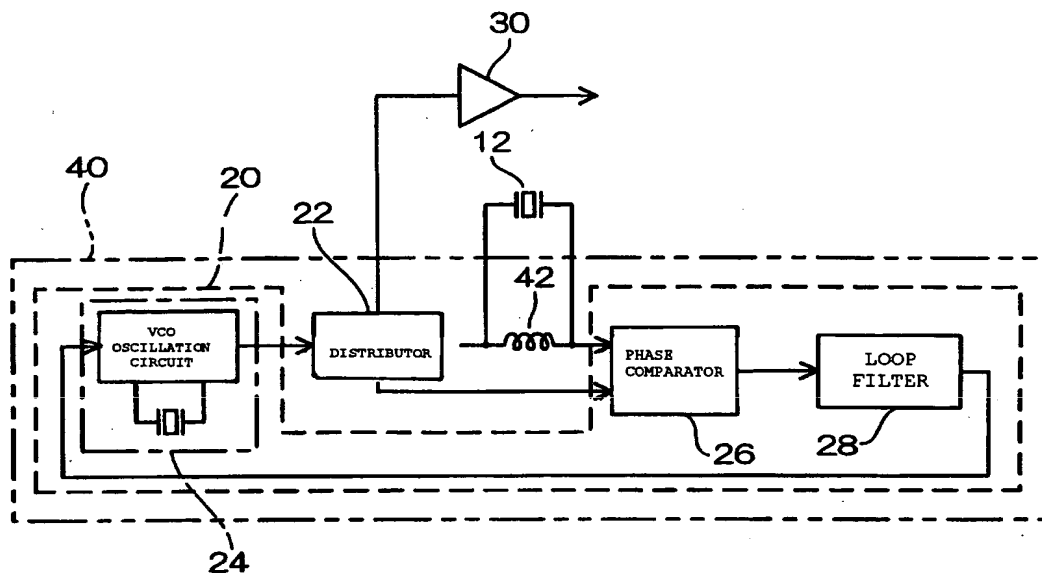
FIG. 3



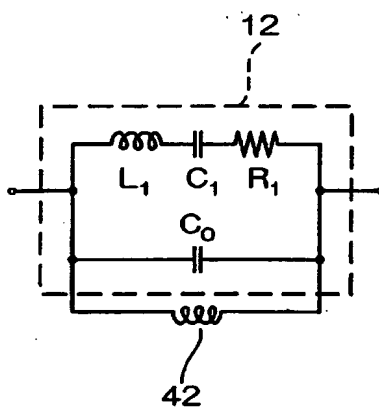
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FIG. 4

(1)



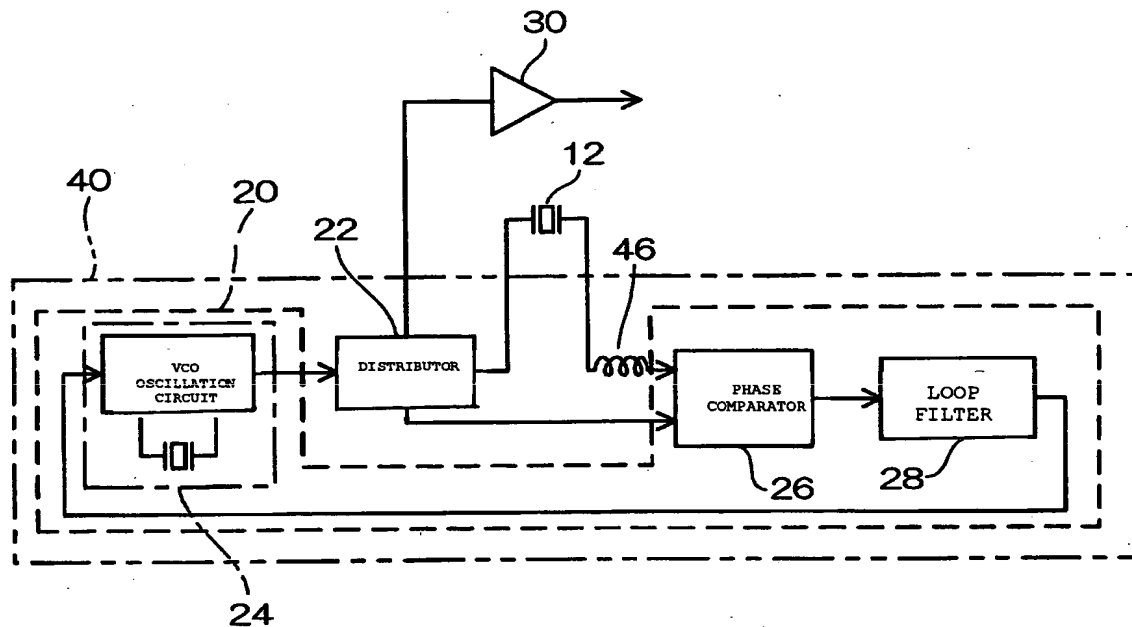
(2)



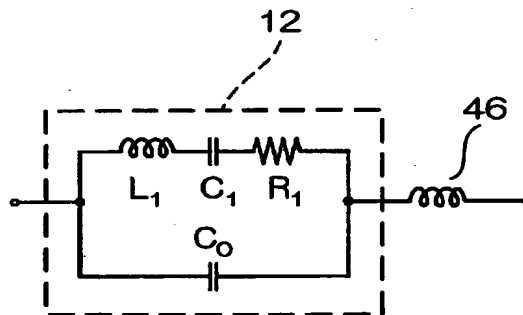
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FIG. 5

(1)

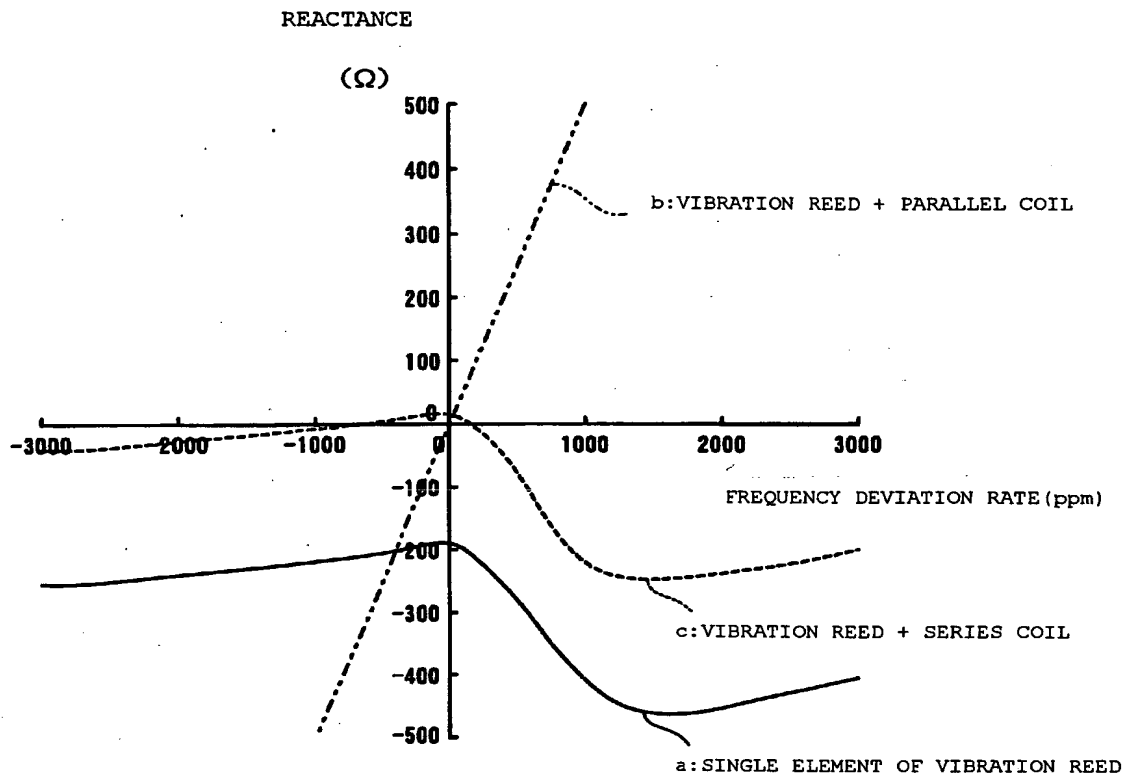


(2)



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FIG. 6



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FIG. 7

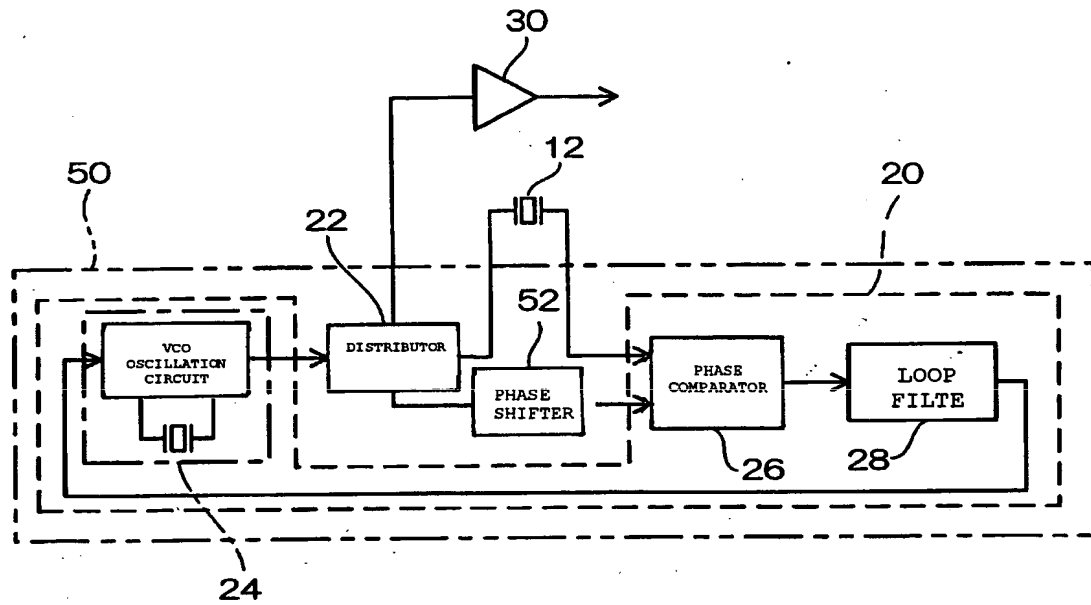
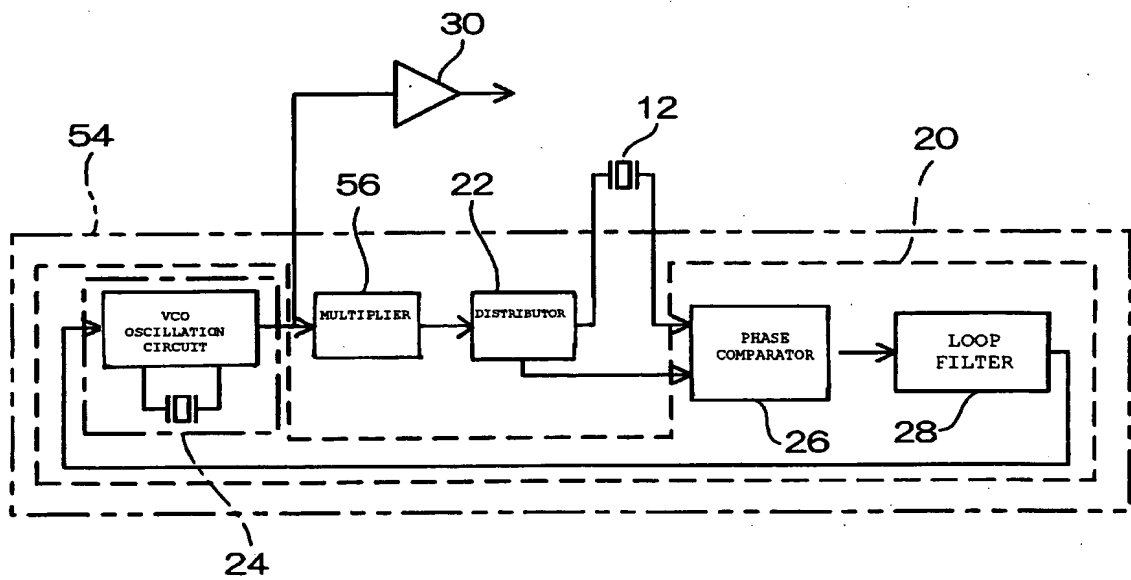
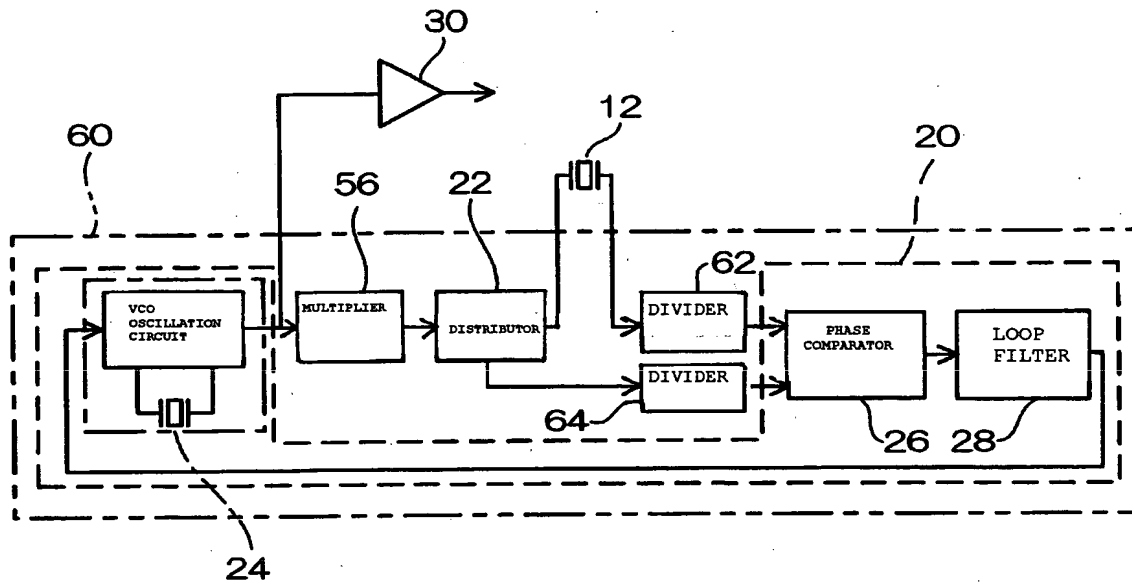


FIG. 8



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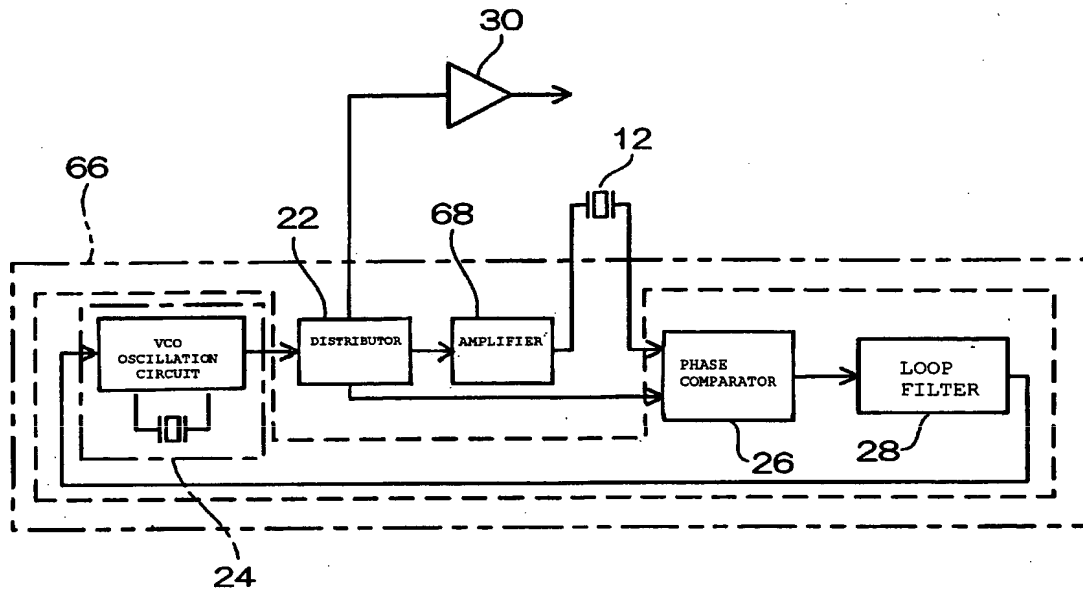
FIG. 9





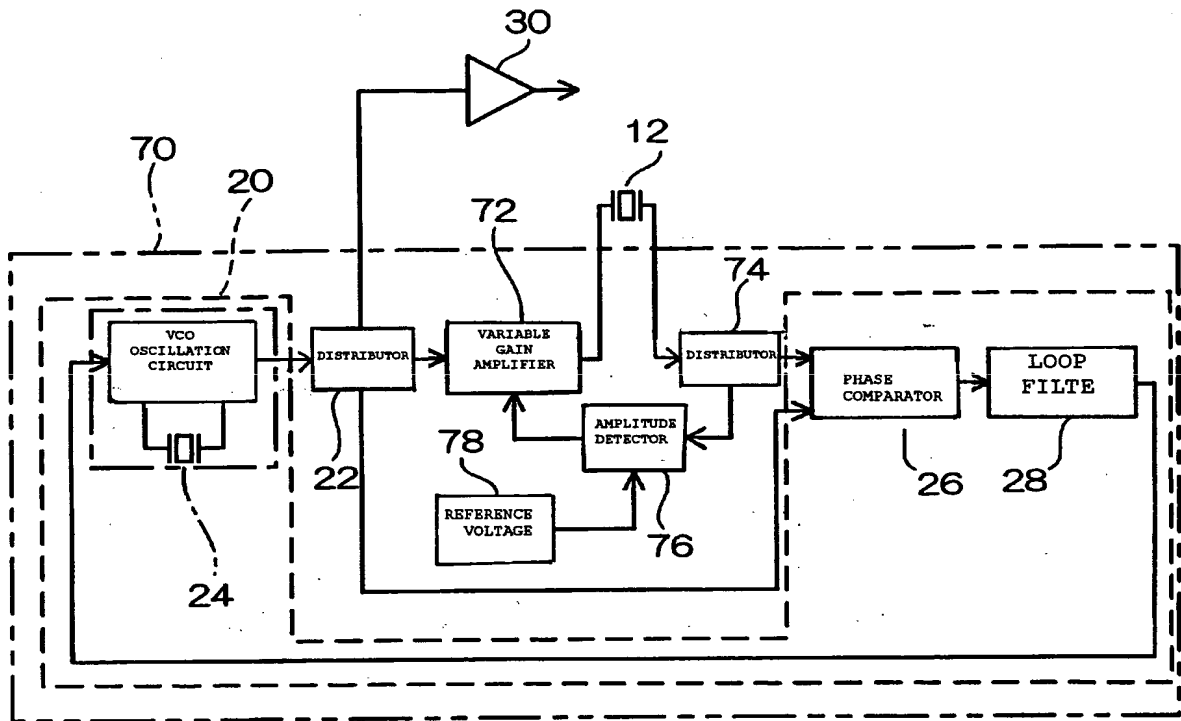
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FIG. 10



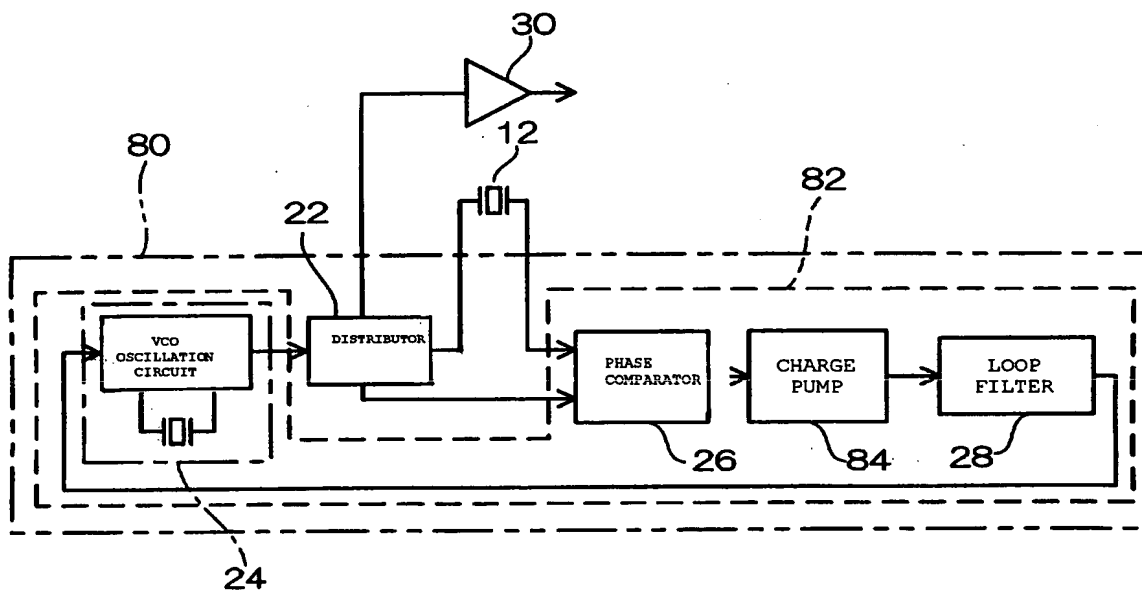
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FIG. 11



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FIG. 12



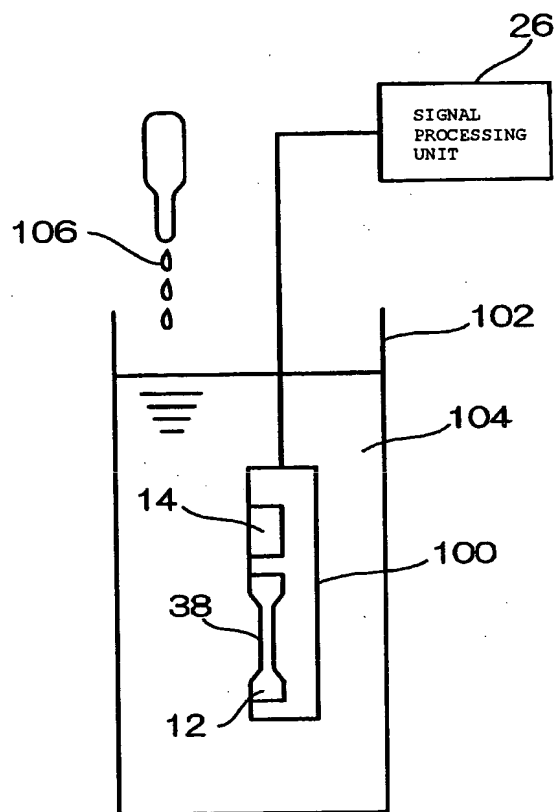
The block diagram illustrates a PLL system with digital control. A dashed box labeled 86 encloses the analog components: a VCO OSCILLATION CIRCUIT (24) which includes a feedback loop with a divider (22), a DISTRIBUTOR (22), and a PHASE COMPARATOR (26). The output of the VCO OSCILLATION CIRCUIT is connected to the DISTRIBUTOR. The output of the DISTRIBUTOR is connected to the PHASE COMPARATOR and also to a buffer (30). The output of the PHASE COMPARATOR is connected to a MICRO COMPUTER (90) within a dashed box labeled 88. The MICRO COMPUTER (90) is connected to a DSP (89), which is connected to a D/A (92). The output of the D/A is connected back to the VCO OSCILLATION CIRCUIT (24) to provide a digital-to-analog feedback signal.

The diagram shows a PLL system 20. A VCO Oscillation Circuit 22 is connected to a Divider 24, which is a multi-bit divider with outputs 12a, 12b, ..., 12n. The outputs of the divider are connected to a Switch Unit 96. The Switch Unit 96 is connected to a Phase Comparator 26. The Phase Comparator 26 is connected to a Loop Filter 28. The output of the Loop Filter 28 is connected to the VCO Oscillation Circuit 22. The output of the VCO Oscillation Circuit 22 is also connected to an output terminal 30.

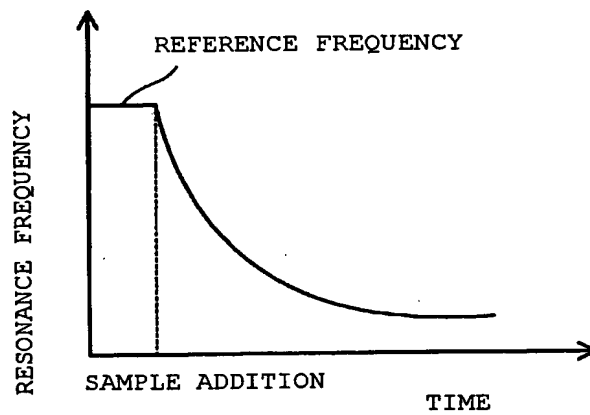
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FIG. 15

(1)

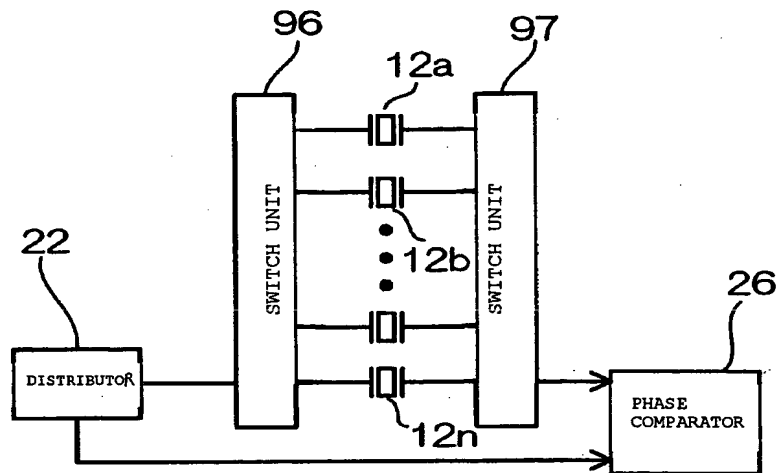


(2)



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FIG. 16



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FIG. 17

